Appendix A Annotated Bibliography

Allmendinger, N.E., Pizzuto, J.E., Moglen, G.E., & Lewicki, M. (2007). A sediment budget for urbanizing watershed, 1951-1996, Montgomery County, Maryland, U.S.A. *Journal of the American Water Resources Association,* 43 (6), 1483-1498.

The authors, a geomorphologist at Otak, Inc. and researchers at the University of Delaware, the University of Maryland, and the USDA Forest Service, used a variety of indirect and stratigraphic data to assess the sediment budget for the Good Hope Tributary watershed in Montgomery County, Maryland. Regression equations determined that channel cross-sectional area was correlated to development within the watershed. Results of their investigation indicated that upland erosion, channel enlargement, and floodplain storage are all significant components of the sediment budget and that the remobilized "legacy" sediments contribute less than 20% and are not a dominant component of sediment yield.

Anderson Jr., W.P., Anderson, J.L., Thaxton, C.S., & Babyak, C.M. (2010). Changes in stream temperatures in response to restoration of groundwater discharge and solar heating in a culverted, urban stream. *Journal of Hydrology,* 393, 309-320.

The authors, researchers at Appalachian State University and the University of South Carolina, used a Monte Carlo thermal mixing model to predict the effect of removing a 700-m-long culvert. The model incorporated cooling effect from restored baseflow and surface-heat exchange effects. Modeled temperatures suggest a decrease in summer stream temperatures in a hypothetically restored stream with removal of a long culvert.

Andrews, D.M., Barton, C.D., Kolka, R.K., Rhoades, C.C., & Dattilo, A.J. (2011). Soil and water characteristics in restored canebrake and forest riparian zones. *Journal of the American Water Resources Association,* 47 (4), 772-784.

The authors, a botanist at the Tennessee Valley Authority and researchers at Pennsylvania State University, the University of Kentucky, and the USDA Forest Service, evaluated the use of giant cane in riparian restoration to compare water quality and soil attributes between restored cane and forest communities. Experimental plots, some planted entirely with cane, some with a mixture of forest hardwood species, and some undisturbed, were combined with stream and groundwater sampling to determine water quality improvement. Significant differences in groundwater DO, NO_3-N, NH_4-N, and Mn between the two vegetation types seems to indicate that redox conditions were not similar. The authors concluded that additional monitoring is needed but that both vegetative communities are transitioning toward the undisturbed plots.

Baldigo, B.P., Ernst, A.G., Warren, D.R., & Miller, S.J. (2010). Variable responses of fish assemblages, habitat, and stability to natural-channel-design restoration in Catskill Mountain streams. *Transactions of the American Fisheries Society,* 139, 449-467.

The authors, researchers at the USGS, Cornell University, and the New York City Department of Environmental Protection, conducted fish and habitat surveys at stream sites in the Catskill Mountains of New York before and after restoration using natural-channel-design (NCD) to evaluate the effects of NCD on fish assemblages, habitat, and bank stability. They researchers noticed significant increases in community richness, diversity, species or biomass equitability, and total biomass in most of the restored reaches. They also found bank stability, stream habitat, and trout habitat suitability indices (HIS) improved at most of the restored reaches.

Baldwin, A.H. (2007). *Urban Stream Restoration Best Management Practice* (Recommendations for Formal Approval by the Nutrient Subcommittee's Tributary Strategy and Urban Stormwater Workgroups). Chesapeake Bay Program: Author.

The author, a researcher at the University of Maryland, performed a literature review to evaluate the effectiveness of stream restoration as a Best Management Practice and propose recommended removal efficiencies for use in the Chesapeake Bay Program's Phase 5.0 Watershed Model.

Beechie, T.J., Sear, D.A., Olden, J.D., Pess, G.R., Buffington, J.M., Moir, H., Roni, P., & Pollock, M.M. (2010). Process-based principles for restoring river ecosystems. *BioScience,* 60 (3), 209-222.

The authors, research fish biologists at NOAA, a watershed program manager, research geomorphologists at the US Forest Service and the Macaulay Institute, and researchers at the University of Southampton and University of Washington, outline and illustrate four principles for process-based stream restoration to ensure sustainable actions in terms of the physical, chemical, and biological processes of streams. The authors discuss the key components of process-based restoration and give examples for a variety of applications.

Berg, J. (Ed.). (2009). A new paradigm for water resources management. *Water Resources Impact,* 11 (5).

This issue, containing articles from several researchers from a variety of backgrounds, discusses the current situation of streams, suggesting that colonial land clearing practices changed stream valley morphologies from broad, shallow systems to narrow, deep channels. Case studies of these stream morphologies are discussed along with potential approaches for effective and efficient restoration and management.

Bergmann, K. Fava, J., & Clauser, A. (2011). *Using a bank erosion and deposition protocol to determine sediment load reductions achieved for streambank restorations.* Poster session presented at the Delaware Estuary Science and Environmental Summit, Cape May, NJ.

The authors of this poster, researchers from the Brandywine Valley Association and Clauser Environmental, used bank pins to measure erosion/deposition in three study reaches to determine efficiency of potential restorations. The authors found highest erosion/deposition values in the unstabilized, proposed restoration reach.

Bernhardt, E.S., Palmer, M.A., Allan, J.D., Alexander, G., Barnas, K., Brooks, S., Carr, J., Clayton, S., Dahm, C., Follstad-Shah, J., Galat, D., Gloss, S., Goodwin, P., Hart, D., Hassett, B., Jenkinson, R., Katz, S., Kondolf, G.M., Lake, P.S., Lave, R., Meyer, J.L., O'Donnell, T.K., Pagano, L., Powell, B., & Sudduth, E. (2005). Synthesizing U.S. river restoration efforts. *Science,* 308, 636-637.

The authors, researchers from several universities and government agencies, discussed the results of evaluating more than 37,000 river restoration projects in the U.S. as part of the National River Restoration Science Synthesis (NRRSS) database. The NRRSS database separated projects into 13 categories and classified each according to its stated restoration goal. Restoration efforts and costs varied greatly across geographic regions. The authors concluded that a comprehensive assessment of restoration progress within the U.S. is not feasible and that more monitoring is needed to determine the effectiveness of stream restoration projects.

Brush, G.S. (2008). Historical land use, nitrogen, and coastal eutrophication: a paleoecological perspective. *Estuaries and Coasts,* 32 (1), 18-28.

The author, a researcher at Johns Hopkins University, used sediment core analysis throughout the Chesapeake Bay watershed to establish that denitrification opportunities have decreased and nitrogen sources have increased over the past 300 years. This has led to an increasingly eutrophic and anoxic estuary. The author offers some options for reducing nitrogen from entering the estuary, including increasing opportunities for denitrification, retrofitting septic systems, and restoring wetlands.

Bukaveckas, P.A. (2007). Effects of channel restoration on water velocity, transient storage, and nutrient uptake in a channelized stream. *Environmental Science & Technology,* 41 (5), 1570-1576.

The author, a researcher at Virginia Commonwealth University, evaluated the effects of restoration on a 1-km segment of Wilson Creek in Kentucky by measuring water velocity, transient storage, and nutrient uptake in both channelized (unrestored) sections and naturalized (restored) sections. Injection experiments were performed in both study reaches, resulting in a 50% increase in median travel time and significantly higher first-order uptake rate coefficients for N and P in the restored section. The author suggests that decreased velocities and a longer, meandering channel enhances nutrient uptake in restored streams as opposed to channelized streams.

Cadenasso, M.L., Pickett, S.T.A., Groffman, P.M., Band, L.E., Brush, G.S., Galvin, M.F., Grove, J.M., Hagar, G., Marshall, V., McGrath, B.P., O'Neil-Dunne, J.P.M., Stack, W.P., & Troy, A.R. (2008). Exchanges across land-water-scape boundaries in urban systems. *Annals of the New York Academy of Sciences,* 1134, 213-232.

The authors, researchers at the University of California-Davis; the Cary Institute of Ecosystem Studies; the University of North Carolina; Johns Hopkins University; the Maryland Department of Natural Resources; the USDA Forest Service; the Parks and People Foundation in Baltimore;

Columbia University; Parsons, The New School for Design; the University of Vermont; and the Baltimore City Department of Public Works, examined two urban restoration projects aimed at reducing nitrate pollution. The authors present five types of strategies to enhance nitrogen storage in urban landscapes, focusing on biogeophysical strategies such as watershed alteration and stream restoration.

Craig, L.S., Palmer, M.A., Richardson, D.C., Filoso, S., Bernhardt, E.S., Bledsoe, B.P., Doyle, M.W., Groffman, P.M., Hassett, B.A., Kaushal, S.S., Mayer, P.M., Smith, S.M., & Wilcock, P.R. (2008). Stream restoration strategies for reducing river nitrogen loads. *Frontiers in Ecology and the Environment,* 6.

The authors, researchers from several universities, government agencies, and a non-profit research center, discuss a framework for prioritizing restoration sites. They suggest that small streams with larger nitrogen loads delivered during low to moderate flows offer the greatest opportunity for nitrogen removal. In their discussion, they use examples from the Chesapeake Bay watershed.

Doheny, E.J., Dillow, J.J.A., Mayer, P.M., & Striz, E.A. (2012). *Geomorphic Responses to Stream Channel Restoration at Minebank Run, Baltimore County, Maryland, 2002-08* (Scientific Investigations Report 2012-5012). Reston, VA: U.S. Geological Survey.

The authors, researchers at the USGS and the USEPA, collected data prior to and after restoration of Minebank Run to assess geomorphic characteristics and geomorphic changes over time. Among their findings, over six years of monitoring, the stream is maintaining an overall slope of the channel bed and water surface, on average, despite changes in location, distribution, and frequency of riffles, pools, and runs. Comparing pre and post restoration data suggests reduction of lateral erosion. They also found a relationship between channel geometry and discharge.

Doyle, M.W., & Ensign, S.H. (2009). Alternative reference frames in river system science. *Bioscience,* 59 (6), 499-510.

The authors, researchers at North Carolina at Chapel Hill, apply alternative reference frames on river systems. They illustrate the use of alternative reference frames compared to traditional methods using the following examples: sediment transport, fish migration, and river biogeochemistry. The researchers demonstrate how using alternative or non-intuitive reference frames can facilitate novel research questions and observations, potentially triggering new research trajectories.

Doyle, M.W., Stanley, E.H., & Harbor, J.M. (2003). Hydrogeomorphic controls on phosphorus retention in streams. *Water Resources Research,* 39 (6), 1-17.

The authors, researches at the University of North Carolina at Chapel Hill; the University of Wisconsin; and Purdue University, examined the influence of biochemical uptake process and hydrogeomorphology on molybdate reactive phosphorus (MRP) retention within a stream reach. The researchers focused on a stream reach that was undergoing channel adjustment in response to a downstream dam removal. They found that uptake rates should have a stronger influence on reach-scale MRP retention than changing channel morphology or hydrology.

Doyle, M.W., Stanley, E.H., Strayer, D.L., Jacobson, R.B., & Schmidt, J.C. (2005). Effective discharge analysis of ecological processes in streams. *Water Resources Research,* 41, 1-16.

The authors, researchers at the University of North Carolina at Chapel Hill; University of Wisconsin; Institute of Ecosystem Studies; the Columbia Environmental Research Center; and Utah State University, used the concept of effective discharge to analyze the interaction between frequency and magnitude of discharge events on selected stream ecological processes. Their results indicate that a range of discharges is important for different ecological processes in a stream. The researchers suggest four types of ecological response to discharge variability: discharge as a transport mechanism, regulator of habitat, process modulator, and disturbance.

Endreny, T.A., & Soulman, M.M. (2011). Hydraulic analysis of river training cross-vanes as part of post-restoration monitoring. *Hydrology and Earth System Sciences,* 15, 2119-2126.

The authors, researchers at State University of New York College of Environmental Science and Forestry, conducted post-restoration monitoring and simulation analysis for a Natural Channel Design (NCD) restoration project completed in 2002 in the Catskill Mountains, New York. The authors found that processing monitoring data with hydraulic analysis software provided better information that could help extend project restoration goals and structure stability.

Ensign, S.H., & Doyle, M.W. (2005). In-channel transient storage and associated nutrient retention: evidence from experimental manipulations. *Limnology and Oceanography,* 50 (6), 1740-1751.

The authors, researchers at the University of North Carolina at Chapel Hill, used experimental channel manipulation to examine the effect of in-channel flow obstructions on transient storage and nutrient uptake. In their study areas, they found that in-channel transient storage influenced nutrient uptake in a blackwater stream; however similar results could not be confirmed in an agricultural stream.

Filoso, S., & Palmer, M.A. (2011). Assessing stream restoration effectiveness at reducing nitrogen export to downstream waters. *Ecological Applications,* 21 (6), 1989-2006.

The authors, researchers at the University of Maryland, evaluated whether stream restoration projects in the Chesapeake Bay region is effective at reducing nitrogen transport to downstream waters. They found that in order for stream restoration to be most effective in reducing nitrogen fluxes transported downstream, strategic restoration designs should be used and include features that enhance the processing and retention of different forms of nitrogen for a wide range of flow conditions.

FISRWG. (1998). *Stream Corridor Restoration: Principles, Processes, and Practices* (GPO Item No. 0120-A). Federal Interagency Stream Restoration Working Group.

The authors, researchers from various federal agencies, collaborated to produce this technical reference on stream corridor restoration. The document reviews the elements of restoration, and provides a framework to plan restoration actions, including no action or passive approaches, partial intervention for assisted recovery, and substantial intervention for managed recovery. The information in the document can be applied to urban or rural setting, and applies to a range of stream types.

Fraley, L.M., Miller, A.J., & Welty, C. (2009). Contribution of in-channel processes to sediment yield of an urbanizing watershed. *Journal of the American Water Resources Association,* 45 (3), 748-766.

The authors, researchers at the Center for Watershed Protection and the University of Maryland, conducted a study to monitor sediment transport and storage in a tributary of the Schuylkill River in Pennsylvania. They found that bank erosion in their study reach contributed an estimated 43 percent of the suspended sediment load. Although bank erosion is a significant source of sediment, bed sediment storage and potential for remobilization are also important components of the sediment budget.

Harrison, M.D., Groffman, P.M., Mayer, P.M., & Kaushal, S.S. (2012). Microbial biomass and activity in geomorphic features in forested and urban restored and degraded streams. *Ecological Engineering,* 38, 1-10.

The authors, researchers at the University of Maryland, the Cary Institute of Ecosystem Studies, NOAA, and the US EPA, measured sediment denitrification potential (DEA), net nitrification, methanogenesis, and microbial variables in various stream features and in several different stream settings. They found that DEA was higher in organic debris dams and in forest streams, but their results were not statistically significant. They also found that DEA was related to microbial biomass nitrogen and sediment organic matter, and also methanogenesis was active in all stream geomorphic features. Overall, the results suggest that in-stream geomorphic features in urban restored and degraded sites have the potential to function as nitrogen sinks.

Harrison, M.D., Groffman, P.M., Mayer, P.M., Kaushal, S.S., & Newcomer, T.A. (2011). Denitrification in alluvial wetlands in an urban landscape. *Journal of Environmental Quality,* 40, 634-646.

The authors, researchers at the University of Maryland, the Cary Institute of Ecosystem Studies, and the US EPA, measured denitrification rates to compare the variation and magnitude in urban and forested wetlands in the Baltimore metropolitan area. They found that mean denitrification rates did not differ among wetland types, suggesting that urban wetlands have the potential to reduce nitrate in urban watersheds. Their findings also suggest that wetlands are sinks for nitrate year round.

Hartranft, J.L., Merritts, D.J., Walter, R.C., & Rahnis, M. (2011). The Big Spring Run restoration experiment: policy, geomorphology, and aquatic ecosystems in the Big Spring Run watershed, Lancaster County, PA. *Sustain,* 24, 24-30.

The authors, researchers at the Pennsylvania Department of Environmental Protection and Franklin and Marshall College, are investigating whether an anastomosing channel valley bottom floodplain systems can effectively restore critical zone function at Big Springs Run in Pennsylvania. Their approach includes: developing significant metrics to assess critical zone process; developing, implementing, and monitoring a restoration project that diagnoses the causes of impairments; and evaluate the implications of this restoration strategy. At the time of the paper, the researchers had completed three years of pre-restoration monitoring and were anticipating the commencement of restoration activities.

Henshaw, P.C. (1999). Restabilization of stream channels in urban watersheds. *Proceedings of the American Water Resources Association Annual Water Resources Conference on "Watershed Management to Protect Declining Species,"* Seattle, WA.

The author, a researcher at Northwest Hydraulic Consultants, used a variety of field and historical data from streams in urban and urbanizing watersheds to determine the rate and extent of change in channel form over time. The researcher found that restabilization of urbanized stream channels usually occurs in highly urbanized watersheds, and most stabilize within 10 to 20 years of constant land cover in the watershed. The possibility that a channel will restabilize depends mainly on hydrologic and geomorphic characteristics of the channel and its watershed, rather than the magnitude or rate of development.

Hill, T., Kulz, E., Munoz, B., & Dorney, J. (2011). *Compensatory stream and wetland mitigation in North Carolina: an evaluation of regulatory success.* North Carolina Department of Environment and Natural Resources: Author.

The authors, researchers at the North Carolina Department of Environment and Natural Resources and RTI International, investigated regulatory success rates of wetland and stream mitigation projects in North Carolina. They collected information to compare current statewide mitigation project conditions with regulatory requirements during 2007-2009 by reviewing files and directly observing sites. Overall, the researchers found that mitigation success rates, based on whether the mitigation site met the regulatory requirements for the project that were in place at the time of construction, were estimated at 74 percent for wetlands, and 75 percent for streams in North Carolina. They also found that wetland mitigation success rate has increased since the mid 1990's. In addition, the researchers performed a variety of statistical analyses to evaluate the success of mitigation based on various aspects including mitigation provider, method, project location, age, and size.

Hillman, M., & Brierly, G. (2005). A critical review of catchment-scale stream rehabilitation programmes. *Progress in Physical Geography,* 29 (1), 50-70.

The authors, researchers from Macquarie University and the University of Auckland, performed a literature review and examined case studies of contemporary catchment-wide programs. They found the following challenges in programs: generating an authentic and functional biophysical vision at the catchment scale, developing a proactive adaptive management approach, achieving genuine community participation, and integrating biophysical and social factors in a transdisciplinary framework. They suggest addressing issues of scale, natural variability and complexity to meet those challenges.

Johnson, P.A., Tereska, R.L., & Brown, E.R. (2002). Using technical adaptive management to improve design guidelines for urban instream structures. *Journal of the American Water Resources Association,* 38 (4), 1143-1152.

The authors, a researcher from Penn State University and engineers from Erdman, Anthony, Associates, Inc. and the Central Federal Lands Highway Division of the FHA, used technical adaptive management to update guidelines for effective use, design, and construction of instream structures. They note that monitoring, evaluation of data, and communication of results are crucial components of the adaptive management process to prevent future failures. They used three case studies of urban streams in Maryland to provide data for updating and improving the Maryland guidelines.

Kaushal, S.S., Groffman, P.M., Mayer, P.M., Striz, E., & Gold, A.J. (2008). Effects of stream restoration on denitrification in an urbanizing watershed. *Ecological Applications,* 18 (3), 789-804.

The authors, researchers at the University of Maryland, the Institute of Ecosystem Studies, the U.S. EPA, and the University of Rhode Island, used in situ measurements of ^{15}N tracer additions to determine if hydrologic reconnection of a stream to its floodplain could increase rates of denitrification in an urban stream. Mean rates of denitrification were significantly greater in restored reaches and restored riparian areas with hydrologically connected stream banks had higher rates of denitrification than similarly restored riparian areas with high, nonconnected banks. Stream restoration designed to reconnect stream channels and floodplains can increase denitrification rates but there can be substantial variability in the efficacy of restoration designs.

Klocker, C.A., Kaushal, S.S., Groffman, P.M., Mayer, P.M., & Morgan, R.P. (2009). Nitrogen uptake and denitrification in restored and unrestored streams in urban Maryland, USA. *Aquatic Sciences,* 71, 411-424.

The authors, researchers at the University of Maryland, the Cary Institute of Ecosystem Studies, and the US EPA National Risk Management Research Lab, analyzed nitrogen processes to quantify nitrate uptake in restored and unrestored streams in Baltimore, Maryland. They found that denitrification potential in sediments varied across streams, and nitrate uptake length appeared to be correlated to surface water velocity. Their results suggest restoration approaches that increase hydrologic "connectivity" with hyporheic sediments and increase hydrologic residence time may influence denitrification rates in stream reaches.

Kroes, D.E., & Hupp, C.R. (2010). The effect of channelization on floodplain sediment deposition and subsidence along the Pocomoke River, Maryland. *Journal of the American Water Resources Association,* 46 (4), 686-699.

The authors, an ecologist at the USGS and a botanist at the USGS, studied floodplain sediment dynamics at six sites along the Pocomoke River. They assessed the effects of channelization on sediment deposition, storage, and subsidence along the stream. They found that channelization resulted in limited sediment retention and an increase in sediment deposition in down-stream reaches. In addition, drainage of floodplains resulted in subsidence and release of stored carbon.

Lakly, M.B., & McArthur, J.V. (2000). Macroinvertebrate recovery of a post-thermal stream: habitat structure and biotic function. *Ecological Engineering,* 15, 87-100.

The authors, researchers at the University of Georgia and the Savannah River Ecology Laboratory, conducted a study of macroinvertebrate faunal assemblages, organic matter availability and in stream structural complexity in three systems to determine the current state of recovery of a post-thermal stream. They found that the abundance and diversity of the lower foodchain community has recovered since termination of thermal flows in 1988. They also found that the biotic communities remain structurally and functionally distinct as a result of the thermal disturbance.

Land Studies. (2005). *Stream bank erosion as a source of pollution: research report*. Author.

The author, Land Studies, performed a literature review of stream projects in the Lower Susquehanna watershed in Pennsylvania. Based on the projects they reviewed, they have found that stream bank erosion is a significant source of nonpoint sediment and nutrient pollution. They also mention that legacy sediments could potentially be a significant contributor of sediment and nutrients.

Lautz, L.K., & Fanelli, R.M. (2008). Seasonal biogeochemical hotspots in the streambed around restoration structures. *Biogeochemistry,* 91, 85-104.

The authors, researchers at the State University of New York College of Environmental Science and Forestry, examined the seasonal patterns of water and solute fluxes through a streambed near a stream restoration structure. They found that regardless of season of the year, anoxic zones were primarily located upstream of the structure, in a low-velocity pool, and oxic zones were typically located downstream of the structure in a turbulent riffle. They suggest that restoration structures that span the full channel, such as those used in natural channel design restoration, will influence the biogeochemical processing in the streambed.

Mayer, P.M., Groffman, P.M., Striz, E.A., & Kaushal, S.S. (2010). Nitrogen dynamics at the groundwater-surface water interface of a degraded urban stream. *Journal of Environmental Quality,* 39, 810-823.

The authors, researchers at the USEPA, the Cary Institute of Ecosystem Studies, and the University of Maryland, investigated groundwater ecosystem in an urban degraded stream near Baltimore, Maryland in the Chesapeake Bay watershed. Their objectives were to identify spatial and temporal extent of chemical, microbial, and hydrological factors that influence denitrification. Their results suggested that denitrification and removal of nitrate in groundwater were limited by dissolved organic carbon (DOC) availability. They observed that groundwater nitrate was highest when groundwater levels were highest, corresponding to high oxidation-reduction potential (ORP), suggesting high groundwater-surface water exchange.

McClurg, S.E., Petty, J.T., Mazik, P.M., & Clayton, J.L. (2007). Stream ecosystem response to limestone treatment in acid impacted watersheds of the Allegheny Plateau. *Ecological Applications,* 17 (4), 1087-1104.

The authors, researchers at West Virginia University and the West Virginia Division of Natural Resources, sampled stream chemistry in addition to collecting physical and biological data in three stream types, acidic, acidic streams treated with limestone, and reference streams in West Virginia. Their objectives were to assess acid-precipitation remediation programs in streams, identify attributes that could not be fully restored, and quantify temporal trends in ecosystem recovery. They did not observe temporal trends in recovery, and their results indicated that the application of limestone sand to acidic streams was effective in recovering some stream characteristics; however, recovery was less successful for others.

Merritts, D., Walter, R., & Rahnis, M.A. (2010). *Sediment and nutrient loads from stream corridor erosion along breached millponds.* Franklin & Marshall College: Author*.*

The authors, researchers at Franklin and Marshall College, assessed sediment production rates, nutrient contents, and erosion mechanisms of stream corridor sediments in the Chesapeake Bay watershed. They found that stream corridor erosion, especially stream bank erosion, is a major contributor to the suspended sediment and particulate-phosphorus loads, in addition to a substantial source of nitrogen loads.

Merritts, D., Walter, R., Rahnis, M., Hartranft, J., Cox, S., Gellis A., Potter, N., Hilgartner, W., Langland, M., Manion, L., Lippincott, S. S., Rehman, Z., Scheid, C., Kratz, L., Shilling, A., Jenschke, M., Datin, K., Cranmer, E., Reed, A., Matuszewski, D., Voli, M., Ohlson, E., Neugebauer, A., Ahamed, A., Neal, C., Winter, A., & Becker, S. (2011) *Philosophical Transactions of the Royal Society A,* 369, 976-1009.

The authors, researchers at Franklin and Marshall College, the PA Department of Environmental Protection, the USGS, Dickinson College, and Johns Hopkins University, used LIDAR, field data, and case studies of breached dams in rural and urban watersheds to determine whether stream incision, bank erosion, and increased sediment load is caused by land use changes. In the case of valleys impacted by milldams, modern incised streams represent a transient response to base-level forcing and major changes in historic land use.

Miller, J.R., & Kochel, R.C. (2010). Assessment of channel dynamics, in-stream structures and post-project channel adjustments in North Carolina and its implications to effective stream restoration. *Environmental Earth Sciences,* 59, 1681-1692.

The authors, researchers at Western Carolina University and Bucknell University, analyzed data collected during site assessments and monitoring of 26 restoration sites in North Carolina. Their results suggest that the channel reconfiguration of reaches in a state of equilibrium, which do not exhibit excessive erosion or deposition along highly dynamic rivers is currently problematic. They propose use of a conceptual framework based on geomorphic parameters to assess the likelihood of a project's success.

Montana Department of Environmental Quality. (2009). *Shields River Watershed Water Quality Planning Framework and Sediment TMDLs* (Y02-TMDL-01A). Helena, MT: Author.

The author, the Montana Department of Environmental Quality, used the BEHI method to estimate sediment delivery from stream banks. The method predicts stream erosion rate to sampled stream banks, creating an extrapolation factor from the results, and applying this extrapolation factor to the total length of the streams. The method was used in the Shields watershed to predict bank erosion rates based on BEHI ratings developed from collected field data.

Naiman, R.J., & Melillo, J.M. (1984). Nitrogen budget of a subarctic stream altered by beaver (Castor canadensis). *Oecologia,* 62, 150-155.

The authors, researchers at Woods Hole Oceanographic Institution and the Marine biological Laboratory, measured rates of nitrogen dynamics to construct a nitrogen budget and quantify the influence of beavers on stream eco-systems. They found that changes after impoundment include reduction in allochthonous nitrogen and an increase in nitrogen fixation by sediment microbes. In general, the modified section accumulated a significant amount of nitrogen than before alteration.

Niezgoda, S.L., & Johnson, P.A. (2007). Case study in cost-based risk assessment for selecting a stream restoration design method for a channel relocation project. *Journal of Hydraulic Engineering,* 133 (5), 468-481.

The authors, researchers at the University of Wyoming and Penn State University, used a case study of a stream in central Pennsylvania to illustrate a cost-based risk assessment method to address complexities and uncertainties involved with stream restoration design. During the case study, the researchers found that uncertainty and risk was reduced using the risk-based method by detecting design deficiencies that the initial design overlooked.

Northington, R.M., & Hershey, A.E. (2006). Effects of stream restoration and wastewater treatment plant effluent on fish communities in urban streams. *Freshwater Biology,* 51, 1959-1973.

The authors, researchers at the University of North Carolina at Greensboro, assessed fish community characteristics, resource availability and resource use in three headwater urban streams in North Carolina. The three site types the researchers looked at were a restored urban, an unrestored urban, and a forested sited located downstream of urbanization, and that was impacted by effluent from a wastewater treatment plant (WWTP). At sites sewage-influence sites, the researchers found that the WWTP affected isotope signatures in the biota and they observed lower richness and abundance of fish. They also observed that the restored sites tended to have higher fish richness and greater abundances, compared to unrestored sites. In addition, the researchers conducted additional isotope analysis to determine terrestrial influences on fish.

Northington, R.M., Benfield, E.F., Schoenholtz, S.H., Timpano, A.J., Webster, J.R., & Zipper, C. (2011). An assessment of structural attributes and ecosystem function in restored Virginia coalfield streams. *Hydrobiologia,* 671, 51-63.

The authors, researchers at Virginia Polytechnic Institute and State University, assessed restoration on stream sections affected by surface coal mining activities by evaluating structure and function ecosystem variables in restored and unrestored sections. They observed that in streams affected by mining, macroinvertebrate assemblages in streams were considered stressed and habitat ratings varied between fair and optimal. They found no site differences for any physicochemical or functional variables. In unrestored streams, invertebrate community metric scores tended to be higher.

Orzetti, L.L., Jones, R.C., & Murphy, R.F. (2010). Stream condition in Piedmont streams with restored riparian buffers in the Chesapeake Bay watershed. *Journal of the American Water Resources Association,* 46 (3), 473-485.

The authors, researchers at Ecosystem Solutions and George Mason University, evaluated the efficacy of restored forest riparian buffers along streams in the Chesapeake Bay watershed by examining habitat, water quality variables, and benthic macroinvertebrate community metrics. They found that in general, habitat, water quality, and benthic macroinvertebrate metrics improved with age of restored buffer, with noticeable improvements within 5 to 10 years following restoration.

Palmer, M. (2009). Western Chesapeake Coastal Plain stream restoration targeting. (319(h) program report). *Chesapeake Biological Laboratory – UMCES*.

The author, a researcher at the Chesapeake Biological Laboratory at the University of Maryland, monitored restored and degraded streams positioned in the headwater and the tidal boundary of a watershed in the Chesapeake Bay region. The project quantified nutrient reductions in restored streams where channel restoration practices had been implemented. The information in the project can be used to help develop a strategy for targeting stream restoration implementation in other watersheds in the same region, and to help improve predictions of nitrogen and TSS export in streams in Maryland.

Richardson, C.J., Flanagan, N.E., Ho, M., & Pahl, J.W. (2011). Integrated stream and wetland restoration: a watershed approach to improved water quality on the landscape. *Ecological Engineering,* 37, 25-39.

The authors, researchers at the Duke University Wetland Center, monitored water quality to assess the cumulative effect of restoring multiple portions of the Upper Sandy Creek and former adjacent wetlands. The researchers applied stream/riparian floodplain restoration, storm water reservoir/wetland complex, and a surface flow treatment wetland. The restoration resulted in functioning riparian hydrology that reduced downstream water pulses, nutrients, coliform bacteria, sediment, and stream erosion. They found that nitrate + nitrite loads were reduced by 64 percent, phosphorus loads were reduced by 28 percent, and sediment retention totaled almost 500 MT/year.

Rosgen, D.L. (2001). A practical method of computing streambank erosion rate. *Proceedings of the 7th Federal Interagency Sediment Conference.* Reno, Nevada.

The author, a researcher at Wildland Hydrology, Inc., uses a prediction model to quantitatively predict streambank erosion rates as a tool to apportion sediment contribution of streambank sediment source to the total load transported by a river. The model converts various stream parameter measurements and data to a normalization index for application for a range of stream types. The author also tested the indices against measured annual streambank erosion rates and presents various applications of the prediction method.

Selvakumar, A., O'Connor, T.P., & Struck, S.D. (2010). Role of stream restoration on improving benthic macroinvertebrates and in-stream water quality in an urban watershed: case study. *Journal of Environmental Engineering,* 136 (1), 127-139.

The authors, researchers at the USEPA and Tetra Tech, conducted pre and post restoration monitoring of a stream in Fairfax, Virginia to evaluate the effectiveness of stream bank and channel restoration as a way to improve in-stream water quality and biological habitat. After two years of monitoring, results indicated an improvement in biological quality for macroinvertebrate indices, however, all indices were below the impairment level, signifying poor water quality conditions. Their results also suggested that stream restoration alone had little effect on improving the conditions of in-stream water quality and biological habitat, although it lessened further degradation of stream banks.

Shields, C.A., Band, L.E., Law, N., Groffman, P.M., Kaushal, S.S., Savva, K., Fisher, G.T., & Belt, K.T. (2008). Streamflow distribution of non-point source nitrogen export from urban-rural catchments in the Chesapeake Bay watershed. *Water Resources Research,* 44, 1-13.

The authors, researchers at the University of North Carolina at Chapel Hill, the Center for Watershed Protection, the Institute of Ecosystem Studies, the University of Maryland, the USGS, and the USDA Forest Service, measured nitrogen concentration and discharge measurements to estimate loads. Their goal was to evaluate the impacts of urbanization on magnitude and export flow distribution of nitrogen in various urban and rural catchments. Forested, suburban, and agricultural catchments exported most of the total nitrogen and nitrate loads at lower flows, and conversely, urbanized sites exported total nitrogen and nitrate at higher and less frequent flows.

Sholtes, J.S., & Doyle, M.W. (2011). Effect of channel restoration on flood wave attenuation. *Journal of Hydraulic Engineering,* 137 (2), 196-208.

The authors, researchers at Brown and Caldwell, and the University of North Carolina at Chapel Hill, used a dynamic flood routing model to route floods in impaired and restored reach models, and examined the effectiveness of channel restoration on flood attenuation. Their analyses found that restoration most impacted floods of intermediate magnitude; however, their study shows that the current small scale of channel restoration will provide minimal enhancement to flood attenuation.

Sivirichi, G.M., Kaushal, S.S., Mayer, P.M., Welty, C., Belt, K.T., Newcomer, T.A., Newcomb, K.D., & Grese, M.M. (2010). Longitudinal variability in streamwater chemistry and carbon and nitrogen fluxes in restored and degraded urban stream networks. *Journal of Environmental Monitoring,* 13, 288-303.

The authors, researchers at the University of Maryland, the USEPA, and the USDA Forest Service, monitored surface and hyporheic water chemistry of restored and unrestored streams combined with a mass balance approach to investigate total dissolved nitrogen (TDN) and dissolved organic carbon (DOC) dynamics and in-stream retention and transformation processes. They found considerable reach-scale variability in biogeochemistry. TDN concentrations were typically higher than DOC in restored streams, and the opposite in unrestored streams. The mass balance in restored streams showed net uptake of TDN, and a net release of DOC, and the opposite pattern in unrestored streams.

Smith, S.M., & Prestegaard, K.L. (2005). Hydraulic performance of a morphology-based stream channel design. *Water Resources Research,* 41, 1-17.

The authors, researchers at the Maryland Department of Natural Resources and the University of Maryland, monitored a rehabilitation project in a reach of Deep Run in Maryland to assess commonly used approaches to channel design. They found that the constructed channel was morphologically and hydraulically different from the original channel, and was unsuitable. Their findings demonstrate the need for enhanced consideration of the relationship between channel stability and hydraulic conditions at multiple scales over a range of flow conditions in stream rehabilitation projects.

Sudduth, E.B., Hassett, B.A., Cada, P., & Bernhardt, E.S. (2011). Testing the Field of Dreams hypothesis: functional responses to urbanization and restoration in stream ecosystems. *Ecological Applications,* 21 (6), 1972-1988.

The authors, researchers at Duke University, compared ecosystem metabolism and nitrate uptake kinetics in restoration projects in urban watersheds, unrestored urban streams, and minimally disturbed forested watersheds. They found that stream metabolism did not differ between stream types in either summer or winter, and that nitrate uptake kinetics was not different between stream types in the winter. They observed restored streams had significantly higher rates of nitrate uptake during the summer, which they found could mostly be explained by stream temperature and canopy cover.

Swan, C.M., & Richardson, D.C. (2008). The role of native riparian tree species in decomposition of invasive tree of heaven (Ailanthus altissima) leaf litter in an urban stream. *Ecoscience,* 15 (1), 27-35.

The authors, researchers at the University of Maryland, analyzed decomposition rates of the invasive tree of heaven, and other native leaf species in an urban stream, complemented with laboratory methods. They found that the invasive leaf experienced rapid breakdown, but was slowed when mixed with native leaves. Their results suggest that the presence of native riparian tree species may mediate how invasive trees decompose in human-impacted streams.

Sweeney, B.W., Czapka, S.J., & Yerkes, T. (2002) Riparian forest restoration: increasing success by reducing plant competition and herbivory. *Restoration Ecology*, 10 (2), 392-400.

The authors, researchers at the Stroud Water Research Center, Ducks Unlimited, Inc., and the USDA Forest Service, assessed seedling survivorship and growth of several species of trees in response to various treatment methods over 4 years at two riparian sites near Chester River, Maryland. They found no significant difference in survivorship and growth between bare-root and containerized seedlings. The survivorship and growth was higher for sheltered versus unsheltered seedlings, and those protected from weeds using herbicide. Overall, the results suggest that crown closure over most small streams needing restoration can be achieve more rapidly by protecting seedlings with tree shelters and controlling competing vegetation with herbicides.

Tullos, D.D., Penrose, D.L, Jennings, G.D., & Cope, W.G. (2009). Analysis of functional traits in reconfigured channels: implications for the bioassessment and disturbance of river restoration. *Journal of the North American Benthological Society,* 28 (1), 80-92.

The authors, researchers at Oregon State University and North Carolina State University, compared physical habitat variables, taxonomic and functional-trait diversities, taxonomic composition, and functional-trait abundances in 24 pairs of control and restored sites in three land use type catchments. They observed that responses to restoration differ between agricultural/rural and urban catchments, and that channel reconfiguration disturbs food and habitat resources in stream ecosystems. Their results also suggest that taxa in restored habitats are environmentally selected for traits favored in disturbed environments.

Tullos, D.D., Penrose, D.L., & Jennings, G.D. (2006). Development and application of a bioindicator for benthic habitat enhancement in the North Carolina Piedmont. *Ecological Engineering,* 27, 228-241.

The authors, researchers at Oregon State University and North Carolina State University, describe the development, application, and evaluation of a method for assessing the effectiveness of stream restoration activities in enhancing four lotic habitats based on the presence of habitat specialists. They compared the presence of indicator genera in restored and unrestored sections to signify restoration success in re-establishing benthic habitats. Their results suggest that habitats in urban areas indicated the greatest enhancement, while the agricultural and rural sites did not show a clear trend of improvement or degradation in response to restoration activities.

U.S. EPA. (2010). *Chesapeake Bay Phase 5 Community Watershed Model. In preparation.* EPA 903S10002 – CBP/TRS-303-10, U.S. Environmental Protection Agency, Chesapeake Bay Program Office, Annapolis, MD.

The author, the USEPA, uses HSPF model code to simulate sediment transport as separate processes on the land and in the river. The document describes the three parts of sediment simulation in the Phase 5.3 Model to represent sediment sources, delivery, and transport in the watershed.

Violin, C.R., Cada, P., Sudduth, E.B., Hassett, B.A., Penrose, D.L., & Bernhardt, E.S. (2011). Effects of urbanization and urban stream restoration on the physical and biological structure of stream ecosystems. *Ecological Applications,* 21 (6), 1932-1949.

The authors, researchers at the University of North Carolina, Duke University, and North Carolina State University, compared the physical and biological structure of four urban degraded, four urban restored, and four forested streams in North Carolina to quantify the ability of reach-scale restoration to restore physical and biological structure. They observed that channel habitat complexity and watershed impervious cover were the best predictors of sensitive taxa richness and biotic index the reach and catchment scale, respectively. Macroinvertebrate communities in restored channels were compositionally similar to those in urban degraded channels. Their results suggest that reach-scale restoration is not successfully mitigating for the factors causing physical and biological degradation.

Waite, L. J., Goldschneider, F. K., & Witsberger, C. (1986). Nonfamily living and the erosion of traditional family orientations among young adults. American Sociological Review, 51 (4), 541-554.

The authors, researchers at the Rand Corporation and Brown University, use data from the National Longitudinal Surveys of Young Women and Young Men to test their hypothesis that nonfamily living by young adults alters their attitudes, values, plans, and expectations, moving them away from their belief in traditional sex roles. They find their hypothesis strongly supported in young females, while the effects were fewer in studies of young males. Increasing the time away from parents before marrying increased individualism, self-sufficiency, and changes in attitudes about families. In contrast, an earlier study by Williams cited below shows no significant gender differences in sex role attitudes as a result of nonfamily living.

Walter, R.C., & Merritts, D.J. (2008). Natural streams and the legacy of water-powered mills. *Science,* 319, 299-304.

The authors, researchers at Franklin and Marshall College, mapped and dated deposits along mid-Atlantic streams that formed the basis for the widely accepted model for gravel-bedded streams. The collected data, along with historical maps and records suggest streams were historically small anabranching channels with extensive vegetated wetlands that accumulated little sediment, and stored organic carbon. They suggest that large numbers of milldams have buried the wetlands with fine sediment. Their findings show that most floodplains along mid-Atlantic streams are actually fill terraces, and historically incised channels are not natural archetypes for meandering streams.

Weller, D.E., Baker, M.E., & Jordan, T.E. (2011). Effects of riparian buffers on nitrate concentrations in watershed discharges: new models and management implications. *Ecological Applications,* 21 (5), 1679-1695.

The authors, researchers at the Smithsonian Environmental Research Center, combined geographic methods with improved statistical models to test the effects of buffers along cropland flow paths on connecting stream nitrate concentrations in the Chesapeake Bay watershed. They developed models that predict stream nitrate concentration from land cover and physiographic province, and compared models with and without buffer terms. They found that on average buffers in the Coastal Plain watersheds had higher nitrate removal potential than other regions. Model predictions for the study watersheds estimated nitrate removals based on existing cropland and buffer distributions, compared to expected nitrate concentrations if buffers were removed. In the Coastal Plain watersheds, current buffers reduce average nitrate concentrations by 0.73 mg N/L, or 50 percent of inputs from cropland, 0.40 mg N/L, or 11 percent in the Piedmont, and 0.08 mg N/L or 5 percent in the Appalachian Mountains. The model also suggests that restoration to close all buffer gaps could further reduce nitrate concentrations.